

MISCELLANEOUS NOTES ON THE HAWAIIAN FLORA I.

Derral Herbst
U.S. Fish & Wildlife Service
P.O. Box 50167
Honolulu, Hawaii 96850

Casual observations made during the course of field work, and peripheral data discovered while researching herbaria or the literature on more specific topics frequently remains in the minds or notebooks of the researchers, unavailable to other workers in the field. This is an unfortunate situation as much of this information is of great value or interest.

The purpose of this, the first of a series of papers, is to record such information on the Hawaiian flora. Short notes on the morphology, taxonomy, biology, distribution and ecology of native and exotic plants in the Hawaiian flora will be presented.

The present paper contains comments on Dubautia, Dissochondrus, Panicum, Bonamia, Liparis and Korthalsella and on additions to the flora of the Leeward Hawaiian Islands.

DUBAUTIA

Three new varieties of Railliardia mistakenly were published twice by E. E. Sherff in 1933. In a later revision of the genus, Sherff (1935) cited the November, 1933 issue of the American Journal of Botany as the place of publication for these varieties. D. D. Keck (1936) and other botanists have followed this incorrect literature citation. It should be noted that the varieties were validly first published in the Botanical Gazette, vol. 95, p. 79, September 1933. The taxa are: Dubautia montana var. longifolia (Sherff) Keck, D. Platyphylla var. leptophylla (Sherff) Keck, and D. menziesii var. angustifolia (Sherff) Keck.

Dubautia sherffiana var. paucinervia (Deg. & Sherff) Herbst. Comb. nov. Railliardia sherffiana var. paucinervia Deg. & Sherff (1951). Am. Journ. Bot. 38:73.

I recently distributed herbarium specimens and seeds of this rare plant from a rather large colony growing

south of Puu Kawiwi, Kamaileunu Ridge, Waianae Mts, Oahu. Because of the number of overlapping characteristics between the two closely related genera, I prefer to consider Railliardia a subgenus of Dubautia.

DISSOCHONDRUS

Dissochondrus is the only genus of grasses endemic to the Hawaiian Islands. Its type and only species, D. biflorus (Hbd.) Ktze, ex Hack., is presently considered a rare plant and has been reported in the literature as occurring only on the islands of Oahu, Molokai and Lanai. As it is now known from all the major islands and is fairly common in the Waianae Mts. of Oahu, I believe that a listing of the Bishop Museum specimens is in order.

- KAUAI: Halemanu, 3,600 feet, Neal s.n., 1929; Mahanaloa Valley, on bare soil, on steep, shaded, north facing slope, el. 1,800 ft., Herbst 2905, 2986, 1973.
- OAHU: Mokuleia, slopes of Kaala, Forbes 1803.0, 1912; Makaleha Ridge, Rock 17081, 1918; Degener without locality, 1932; Palawai Ridge, Degener and Takemoto 10671, 1936; S. Ekahanui, Degener, et. al. 10767, 1936; Pahole Gulch, Mokuleia Forest Reserve, on steep, bare slopes in light to medium shade, el. about 1,800 ft., locally abundant, Herbst 3035, 1973; Ekahanui Gulch, below Puu Kauga, on steep, bare, shaded slopes, el. about 2,300 ft., locally common, Herbst & Obata 5259, 1975; two other collections are from different sub-gulches of Pahola Gulch, Herbst, Obata, Haas, Darwin 5362, 5363, 1975; Kamaileunu Ridge, Waianae Mts., on steep, north facing slope, growing in shaded, bare, loose rocky loam soil in mesic, summer-dry forest, Herbst, Obata, Palmer, Funk, Souza 5967, 1977.
- MOLOKAI: Puu Kolekole, Forbes 219.Mo, 1912; near Laianui, Degener 9155, 1928.
- LANAI: There are no specimens from this island in the Bishop Museum, but the type collection, made by W. Hillebrand, was from Lanai. It was destroyed along with the rest of Hillebrand's angiosperm types, when the Botanisches Museum at Berlin-Dahlem was bombed during World War II.

MAUI: Olowalu Valley, Forbes 2473.M, 1920; Manawai-nui Gulch below Puu Anu on steep, shaded, northeast-facing slope, el. 2,900 ft., Herbst 3022, 1973.

HAWAII: Puuwaawaa, Forbes s.n., 1911.

PANICUM

Panicum nubigenum Kunth - an annual, endemic grass found on dry, low-elevation plains and slopes, has been collected on the islands of Oahu, Mokulua, Molokai, Lanai and Hawaii. While botanizing on Kawelikoa Point, Mahaulepu, Koloa District, Kauai, on October 7, 1971, I found a single, stunted plant (D.H. 2209, BISH) which fits the description of this species.

A subsequent visit on January 28, 1972, during the rainy season, revealed a large but restricted population growing in soil pockets among the rocks on the flat summit of the point, at an elevation of 680 ft. Specimens have been distributed under Herbst 2350.

BONAMIA

Bonamia menziesii Gray is a rare liana which has been found in low, arid regions on all of the main Hawaiian Islands. Dr. L. E. Bishop and I discovered a single plant of this species growing on one of the ridges leading to Mt. Kahili, Kauai. It is a robust plant, apparently well adapted to its middle-elevation, wet forest environment (Herbst and Bishop 2454, BISH, PTBG).

LIPARIS

Liparis hawaiiensis, according to Horace Mann (1867) who first described the species, grows "in mountain woods on trees." Otto and Isa Degener (1965) state that "the plants inhabit forests at low to medium and rarely higher elevations, growing mostly epiphytically and on moss-covered bases of tree trunks; also occasionally on the ground." William Hillebrand (1888) also notes that our native species of Liparis grows "on trees or mossy ground in the lower and middle forests of all islands." All imply that normally it is an epiphyte in wet forests and this indeed is where it usually is found. In Waihoi Valley, Maui, for example, where the species is abundant, the annual rainfall is approximately 250 inches. There it normally grows in dense shade on the trunks and limbs of trees which are festooned with bryophytes.

Terrestrial habitats are less common, and are characterized by ground that is muddy, shaded, and usually rich in organic matter, or are covered with mosses and liverworts.

The plant, with its short rhizomes and two pseudobulbs, each bearing a short-lived leaf, seems better suited for an ecological niche subjected to periods of drought, than to a rain forest. While not previously reported from this niche, Liparis hawaiiensis has been found growing in such an environment.

A small colony of 10 plants grows in an area about 21 ft. in diameter above the cut bank along the jeep trail, Milolii Ridge, Kauai, at an elevation of about 2,400 ft. In December, 1972, five of the six mature plants were in flower. The orchids are growing in bare soil, exposed or in light shade. The vegetation of the area consists of an open, low, mixed growth of Acacia koa and Metrosideros with scattered Dodonea, Styphelia, Wilkesia, Gahnia, Eragrostis variabilis and Pteridium. The ground is mostly bare, but has a thin scattering of dead leaves, Cladonia, and mosses.

A voucher (Herbst and Tannowa 2882, BISH) was collected February, 1973, when the plant was in fruit.

More Liparis were found in a similar environment in May, 1973, during a field trip on Maui with Robert Hobdy, assistant district forester with the State Division of Forestry. Two plants were seen at an elevation of about 2,900 ft. in an open Dodonea, Styphelia, Eragrostis scrub area on the steep eastern slopes of Manawainui Valley. The plants (Herbst and Hobdy 3020, BISH) are growing on bare soil beneath a Styphelia shrub.

Dr. F. R. Fosberg (personal communication) has collected Liparis hawaiiensis in similar localities on Oahu and Lanai. His Lanai specimen was collected on a windswept ridge south of Haalelepaaka, growing on the ground under a bush at about 2,700 ft. elevation (Fosberg 12,424, US). The Oahu specimen was collected in the Waianae Mts., Mokuleia, on a wooded ridge east of the gulch of Puu Kaupakuhale, growing under bushes at about 2,100 ft. (Fosberg and St. John 3927, BISH).

John Obata (personal communication) also has found Liparis growing in a similar situation on Oahu.

KORTHALSELLA

Four native genera of parasitic flowering plants occur in the Hawaiian Islands. Three, Cassytha, Cuscuta and Santalum appear to parasitize all available plants, both native and exotic, while the fourth, Korthalsella,

appears restricted to endemic, woody species. A survey of the specimens in the Bishop Museum and University of Hawaii herbaria, and of all available literature on the Hawaiian species of the genus, reveals that the 10 native taxa of the genus have been found parasitizing 29 genera in 20 families of native plants (Table 1). Most commonly it is found on species of Diospyros, Elaeocarpus, Antidesma, Acacia, Eugenia, Metrosideros, Myrsine, Osmanthus, Bobea, Psychotria, Pelea and Sapindus. Ebenaceae, Leguminosae, Myrtaceae, Oleaceae and Rubiaceae are the most frequently parasitized families. During a field trip to Auahi, Maui, two plants of K. complanata were found as parasites on Solanum sodomium, a common Mediterranean weed (Herbst 1978, BISH, PTBG). To my knowledge, this is the only record of a Hawaiian Korthalsella parasitizing a non native plant.

Korthalsella cylindrica (v. Tiegh.) Engler was considered by Danser, the monographer of the genus, to be endemic to the islands of Oahu, Molokai, Lanai and Maui. The Island of Hawaii can now be added to this list (Webster and Wilbur 1870, Puuwaawaa, north Kona at 2,000 ft., 1948, BISH; Fosberg 41,735, Kaupulehu Forest Reserve, north Kona, where it is common, 1973, BISH; Lamoureux, 1955, HAW; Herbst 1592, Kiholo, Kona on Diospyros, 1970, HAW).

In Korthalsella, a single, flat, oval seed is borne in an elastic fruit. As the fruit matures, internal water pressure increases until, when ripe, the fruit bursts and ejects the seed several feet. A mucilagenous coating enables the seed to stick to any surface it strikes. As the seed germinates, a short radicle develops which penetrates the host plant. It is not uncommon for an ejected seed to stick to the parent plant; I have observed this many times on K. complanata and K. latissima. In many instances the germinating seeds begin to penetrate the parent plant but I have not observed development beyond initial penetration. In contrast to Cassytha and Cuscuta, which frequently sink haustoria into their own stems, Korthalsella appears to inhibit parasitizing by its own kind. The "chemical messenger" involved in this phenomenon would make a very interesting study.

ADDITIONS TO THE FLORA OF THE LEEWARD ISLANDS

Through the courtesy of the Division of Wildlife Refuges, U.S. Fish and Wildlife Service and of the United States Coast Guard, I was able to visit Nihoa, Necker, Tern and Laysan Islands of the Leeward Hawaiian Islands.

An annotated list of plants recently collected from

these islands follows. It includes collections of C. R. Long (Sept., 1964), D. Herbst (Aug. & Sept., 1968 and Sept., 1978) and D. Yen (May 1969).

Nihoa:

A total of nearly three full days were spent on the island (August 24-27, 1968). The following species have appeared in a recent publication (Herbst, 1977b), but are included in this list as additional information is provided.

Cenchrus echinatus var. hillebrandianus (Hitchc.) F.B.H. Brown

Two plants were found growing in a pocket of soil on the floor of Miller Valley at an elevation of about 150 ft. Both were removed and the area searched for seeds, apparently unsuccessful as the taxon was collected by Douglas Yen in 1969.

A joint military operation - HIRAN, Phase II aimed at determining the correct location of each of the Leeward Islands - used the Albatross Plateau above Miller Valley as a helicopter landing pad and as a temporary camp in 1961. Kramer and Swedberg (1961) reported that they had found and burned a towel abandoned by one of the HIRAN team members to which six Cenchrus spikelets were attached. As Miller Valley leads to the easiest point of access to the ocean, it is probable that the seeds were carried down on the towel or other clothing of the HIRAN personnel. Herbst 1206 (BISH, US, HAW); Yen 1010 (BISH).

Setaria verticillata (L.) Beauv.

Near south coast, Yen 1012 (BISH).

Portulaca oleracea L.

I found this species in two places in 1968. The largest population was on Albatross Plateau, where the seeds probably were introduced along with the men and supplies during the HIRAN operation. A small colony of young plants, probably established within the year previous to my visit, is located at the base of Miller Valley on a small rise used as campsite by Fish and Wildlife personnel. Long 2431 (HAW); Herbst 1204, 1205

(BISH, US, HAW); Yen 1001 (BISH).

Ipomoea pes-caprae subsp. *brasiliensis* (L.) v. Oostrstr.

Stony south face, adjacent to east slope of West Palm Valley mouth; el. 100 ft. Yen 1007 (BISH).

Necker:

All five species of plants known to grow on this island were seen, but no others found. Herbst (1977a) recently published on the flora and vegetation of Necker Island. The survey was made on the 28 and 29th of August, 1968.

Tern Island, French Frigate Shoals:

Twelve species of previously unreported plants were collected on Tern Island August 30 to September 1, 1968; and an additional six during my second collection trip on September 11, 1978. Of these eighteen species, three, *Hibiscus*, *Terminalia* and *Conocarpus*, were cultivated plants brought in by Coast Guard personnel to landscape the LORAN station. Three others, *Chloris*, *Salicornia* and *Frankenia*, are new to the Hawaiian flora, but are found in the continental United States and probably were brought in accidentally along with the drums of aviation fuel stockpiled on the northcentral shore of the island, as most were growing around or near the gasoline barrels. The remaining twelve species occur in the Hawaiian Islands and probably were brought in unintentionally with LORAN personnel and supplies.

Following is a list of new additions to the Tern Island flora since Lamoureux's (1961) publication. Several of these species have appeared in subsequent publications (Amerson, 1971 and Fosberg and Sachet, 1975), but are included here so that a record of the disposition of herbarium material is made available.

Chloris petraea Sw.

In 1968, this grass was common in the central and eastern part of the south side of the island; it has now increased greatly in number and covers much more of the island. According to Hitchcock (1951) it is native to "strands, sandy fields, and open pine woods, Coastal

Plain, North Carolina to Florida and Texas; tropical America." In Hawaii, it is known only from Tern Island. Herbst 1221, 6244 (BISH, US, HAW).

Digitaria adscendens (HBK.) Henr.

My notes indicate that in 1968, the plant was common on Tern Island, especially along the edges of the runway. In 1978, it was almost entirely replaced in this area by Sporobolus pyramidatus, and was restricted primarily to several large patches by the boat house of the southwestern part of the island. Herbst 1211, 6225 (BISH, US, HAW).

Eragrostia whitneyi Fosb.

Common along the northeast end of the island. Long 2504 (US, HAW), Herbst 1219 (BISH, US, HAW).

Lepturus repens var. subulatus Fosb.

L. repens has been collected on six of the French Frigate Shoals islands, including Tern Island, where it was quite common in 1978. This taxon, known only from a few small patches on the southcentral part of Tern Island has been tentatively identified by Dr. F. R. Fosberg as L. repens var. subulatus. This variety previously had been known principally from the Central Pacific and Micronesia, but had been collected from Midway and Laysan in the Leeward Hawaiian Islands. Herbst 6236 (BISH, US, HAW).

Fimbristylis cymosa R. Br.

This species was occasional throughout the island, but most common at the eastern end in 1968. It was much more common in 1978. Long 2504 (US, HAW); Herbst 1219, 6245 (BISH, US, HAW).

Chenopodium murale L.

Several large, vigorous plants were found growing along the northeastern part of the island in 1978. Herbst 6222 (BISH, US, HAW).

Salicornia virginica L.

Rare; in 1968, a small colony was growing on bare coralline gravel above the water line by the gas dump, north central side of the island. It probably was washed out during the storm of 1969 as this part of the island was badly damaged by wave action. For a discussion of this collection, see Fosberg and Sachet (1975), page 17. Herbst 1213 (BISH, US, HAW).

Euphorbia glomerifera (Millsp.) L.C. Wheeler

Common on the eastern and central parts of the south side of the island in 1968; not seen in 1978. This species was incorrectly identified as E. thymifolia L. by C. R. Long, and was listed under that name by Amerson (1971). Long 2498 (US, HAW); Herbst 1212 (BISH, US, HAW).

Euphorbia hirta L.

Common on southeastern part of the island in 1968; not seen in 1978. Herbst 1215 (BISH, US, HAW).

Euphorbia prostrata L.

Seen, but not collected by Herbst around the LORAN station, south central part of the island in 1968; not seen in 1978. Long 2505 (US, HAW).

Hibiscus tiliaceus L.

According to Amerson (1971), Judd planted slips of this plant when the Tanager Expedition visited the island June 26, 1923. If they survived, they would have been destroyed in 1942, when the U.S. Navy covered the original Tern Island with coral dredged from the lagoon to create a larger island. In 1968, several small plants of this species were growing near the LORAN station. As the plants were small, and as they were not reported by Lamoureux (1961) or in Long's collection (1964), they probably were brought in by the Coast Guard to landscape the LORAN station shortly before my 1968 trip. The species was not seen in 1978. Herbst 1218 (BISH, US).

Frankenia grandifolia C. & S.

A few plants were found growing around the barrels of aviation fuel at the gas dump, north central side of the islands. This part of the island was badly damaged during the 1969 storm. The top layers of crushed coral from this area were washed away. Later, part of the debris which had washed onto the runway during the storm was pushed into the gas dump area when the runway was cleared. The plant was not seen in 1978. See Fosberg and Sacht (1975), page 20. Herbst 1217 (BISH, US, HAW), det. by Dr. F. R. Fosberg.

Conocarpus erectus L.

A single, small shrub was planted on the south side of the living quarters of the old LORAN station. It was not seen in 1978. Herbst 1216 (BISH).

Terminalia catappa L.

Several young trees were planted around the old LORAN station. A specimen was collected in 1968, but the trees were gone in 1978. As both Conocarpus and Terminalia are so tolerant to salt, these two species probably were destroyed during the construction of the new LORAN facilities rather than during the inundation of the island during the 1969 storm. Herbst 1214 (BISH, US).

Heliotropium curassavicum L.

A common indigenous species which very successfully colonizes newly disturbed coastal areas on the main islands. It was first collected on Tern Island in 1978, and is sparingly distributed throughout the island. Herbst 6223, 6248 (BISH, US, HAW).

Heliotropium procumbens var. depressum (Cham.) Fosb.

This plant is indigenous to Guam and other Pacific basin areas, and is a recent introduction to the Hawaiian Islands. It has recently been collected at Barbers Point; Sand Island; Manoa Campus, U. H.; and Mariners Ridge, Hawaii Kai on Oahu. Herbst 6229 (BISH, US, HAW) is the first non-Oahu collection in Hawaii. As the Coast Guard maintains facilities at

both Sand Island and Barbers Point, it can be assumed that the species is on Tern Island as a result of Coast Guard activities. On Tern Island, the plant is presently found primarily on the south side of the island, where it is becoming rather common.

Plantago lanceolata L.

A single, large plant was seen growing along the south side of the tennis courts. Herbst 6230 (BISH, US).

Fifteen months after my 1968 visit, high seas, caused by a massive storm area in the northern Pacific, swamped Tern Island, covering it with as much as two feet of water from dawn until noon. Three to four foot waves washed across the island, toppling trees and covering it with coral and debris (The Honolulu Advertiser, 1969 and Honolulu Star Bulletin, 1969).

By comparing the species lists from my two visits, after deleting the plants obviously recently introduced for landscaping purposes, the species left probably are those able to withstand short periods of inundation by salt water. However, as my second trip was more than eight years after the storm, and as I was able to spend only three hours on the island during that visit, several factors must be considered when judging the validity of such a list: 1) Some species may have been reintroduced after the storm; most of the plants on the list are common and widely spread throughout the state, and most are easily distributed. No botanical documentation was made during the time between the storm and 1978. 2) Some species adapted to a marine coastal environment, as Salicornia, are no longer on Tern Island. Salicornia and Frankenia both occurred in low numbers and were restricted to one small part of the island; a part of the island badly damaged by wave action. It is possible that they were washed off the island during the storm, with no plants or seeds remaining to reestablish the species. 3) Some species may have disappeared due to non-storm related factors. For example, the Salicornia on Tern Island apparently didn't produce seed; the parent plants may have died of natural causes, leaving no progeny behind. Or more aggressive later introductions may have crowded out less competitive species. 4) Factors indirectly related to the storm must be considered also. The changes in the vegetation as a result of the inundation could bring about changes in

competitive factors leading to the loss of some species.
5) Finally, because of my short stay on the island, some uncommon species may have been missed.

The species which apparently were able to withstand approximately six hours of inundation by salt water, and the wave action are:

<u>Cenchrus echinatus</u>	<u>Boerhavia repens</u>
<u>Chloris petraea</u>	<u>Portulaca lutea</u>
<u>Cynodon dactylon</u>	<u>Portulaca oleracea</u>
<u>Eleusine indica</u>	<u>Spergularia marina</u>
<u>Digitaria adscendens</u>	<u>Tribulus cistoides</u>
<u>Eragrostis whitneyi</u>	<u>Ipomoea pes-caprae</u>
<u>Lepturus repens</u>	<u>Tournefortia argentea</u>
<u>Fimbristylis cymosa</u>	<u>Scaevola taccada</u>
<u>Casuarina equisetifolia</u>	<u>Conyza bonariensis</u>
<u>Chenopodium oahuensis</u>	<u>Pluchea odorata</u>
<u>Cocoloba uvifera</u>	<u>Sonchus oleraceus</u>

Laysan:

Eleven days were spent on the island; from the 3rd to the 14th of September, 1968. Two plants new to the island were recorded:

Cenchrus echinatus L.

According to Ely and Clapp (1973), "This species was probably introduced by military personnel in the 1960's. A single plant found near the campsite on the northwest side of the island was destroyed in March 1969 by BSWF personnel. Two more plants flowering in the same general area in September 1969 were also destroyed."

On September 12, 1968, I found a large clump of the species in the same area. After several herbarium specimens were taken, the remaining portions of the plant were sealed in a plastic bag and taken aboard the ship to be disposed of along with the rest of the garbage accumulated during our stay on the island. I sifted the sand surrounding the plant in an attempt to remove all seeds. Herbst 1223 (BISH, US, HAW).

Chenopodium oahuense (Meyen) Aellen

Ely and Clapp (1973) report a single mature plant near the campsite on the northwestern rim on the island. It

probably grew from seeds collected from plants on French Frigate Shoal which were broadcast in this area in September, 1966. Specimens have been distributed under my number 1226 (BISH, US, HAW). The species appears to be established as seedlings have been reported recently (Ely and Clapp, 1973).

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Table 1: Host plants of Hawaiian Korthalsella.

The following list is based upon a survey of the specimens in the herbaria of the Bishop Museum and the University of Hawaii, and of the available literature on the Hawaiian species of the genus. K. latissima var. crassa (v. Tiegh) Danser is omitted as it is known only from the type collection, and the host of that specimen is unknown. A small number of dubious literature citations also have been omitted. The symbols indicate the islands on which the collections were made. They are: H = Hawaii, K = Kauai, L = Lanai, M = Maui, Mo = Molokai, and O = Oahu.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	<i>K. complanata</i>	<i>K. cylindrica</i> var. <i>cylindrica</i>	<i>K. cylindrica</i> var. <i>teres</i>	<i>K. degeneri</i>	<i>K. latissima</i> var. <i>latissima</i>	<i>K. platycaula</i>	<i>K. remyana</i> var. <i>remyana</i>	<i>K. remyana</i> var. <i>wawrae</i>	<i>K. remyi</i>
Aquifoliaceae									
Ilex	O				O, Mo				
Araliaceae									
Cheirodendron	M				K				
Tetraplasandra	O								
Celastraceae									
Perrottetia	O								
Ebenaceae									
Diospyros	K	O, H					O, M, Mo, L	K	
Elaeocarpaceae									
Elaeocarpus	O					K, O			
Epacridaceae									
Styphelia	M, Mo								
Ericaceae									
Vaccinium	M								
Euphorbiaceae									
Antidesma	K, O, Mo, L				K				
Euphorbia			O						

